REMARKS

The invention, as claimed in independent claims 1, 2, 8, 10, 16, 17 and 18, relates treating a metallic bone implant by treating the implant with a solution of hydrofluoric acid (HF) in a specified concentration or pH range or with a solution containing fluoride atoms in the specified concentration. As noted in the specification at 7, this treatment promotes the strength of attachment of permanent implants in bone and reduces the time it takes to achieve strong bonds. The independent claims recite that the process "consists essentially of" the recited step. From the discussion of examples at page 10, it is seen that implants are merely cleaned before the HF treatment and are merely washed with water and placed in a sterile package to await surgical implantation following the treatment. Thus, the "consisting essentially of" transitional phrase appropriately recites the HF step as the only significant one.

All independent claims have been amended herein to recite that the treating is for a period of time (or duration) and at a temperature selected according to the concentration (or pH) of the solution so as to not cause significant etching of the implant. These amendments relate to the fact that the present invention involves chemical modification of the implant surface (i.e. to retain fluoride/fluorine on the implant surface) with HF without causing significant etching or pitting of the surface, i.e., without significantly affecting the implant surface morphology as in the prior art uses of HF, e.g., JP 3-146679.

Support for this amendment is found on page 4, lines 9-11, page 5, lines 10-16, and page 6, lines 17-19. Thus, temperature and time are selected according to the HF concentration used to obtain the preferred implant surface, i.e., an implant surface having the desired amount of fluoride/fluorine, but without significant etching thereof. This is also expressed, in other words, on page 5, lines 12-16 (and in e.g. claim 20); the implant surface after treatment has essentially the same morphology as before the treatment. Note that the treatment period needed in order to

obtain the desired content of fluoride/fluorine in the surface layer is also due to the thickness of the oxide layer on the implant (page 6, lines 17-19).

Independent claims 1 and 16 recite that the HF solution has a pH in the range 1.6 to 3.0; independent claims 2, 10, 17 and 18 recite a concentration greater than 0% and less than 3%, and independent claim 8 recites a concentration of 0.1% to 2%. HF is a weak acid which is not completely dissociated, but instead has a K_a of 7.2×10^{-4}. Calculations based on this K_a result in the following correspondence between concentration (% by weight) and pH:

concentration	pH
0.2	2.1
2.0	1.6
3.0	1.5

Independent claims 1, 2, 8, 10, 16, 17 and 18 stand rejected as anticipated under 35 USC 102(b) by JP 3-146679.

JP 3-146679 relates to a two-step treatment of an implant surface involving (the references to pages and lines are given in relation to the English translation submitted in the parent application):

(i) immersion in an aqueous solution of 1-6% (w/w) hydrofluoric acid (HF), followed by

(ii) immersion in a mixed solution of 1-6% (w/w) hydrofluoric acid (HF) and 1-10% (w/w) hydrogen peroxide (H2O2) (page 3).

The purpose of the first step is to first remove the natural oxide layer and other contaminants from the surface (page 3) thus leaving the implant surface unprotected to the acid. When the acid is brought into contact with the surface, etching occurs thus providing irregular fine recesses with an average pore size of 1-10 μm and an average depth of 0.5-5 μm on the surface (page 4).

The purpose of the second step is to smooth the sharp edges and thorns formed during the first treatment step (page 4). These sharp edges remaining after the first step are said to be unaccepatable. (page 7). The second step is said to improve the adhesion

strength between implant and bone (page 3). A combination of hydrofluoric acid and hydrogen peroxide are used in the second step. Hydrogen peroxide is very aggressive to metals, such as titanium, and thus results in considerable etching of the metal surface. JP 3-146679 quite clearly teaches that the second step is considered a necessary step.

In contrast, the present invention, as claimed in independent claims1, 2, 8, 10, 16, 17 and 18, relates to a one-step procedure wherein a metallic implant is treated with a solution of hydrofluoric acid in a concentration up to 3% (or expressed in terms of pH) for a period of time and at a temperature selected according to the concentration of the solution without causing significant etching of the implant. The effect of this treatment is that fluoride/fluorine is retained on the implant surface without significant etching thereof. Fluoride/fluorine on an implant surface without significant etching is believed to provide an improved biocompatibility, in particular an improved rate of bone tissue attachment and strength (specification, page 4, line 29 to page 5, lines 2).

Independent claims 1, 2, 8, 10, 16, 17 and 18 specify that the treating is under conditions without causing significant etching of the implant. JP 3-146679 is to the contrary, and teaches treating under conditions that intentionally do achieve significant etching. This provides a first reason for lack of anticipation under 35 USC 102(b), and, as discussed in more detail below, provides a basis for nonobviousness under 35 USC 103(a).

Independent claims 1, 2, 8, 10, 16, 17 and 18 are each limited to a single significant step and are thus not anticipated by the disclosure of a two-step procedure in JP 3-146679. This provides second reason for lack of anticipation, and nonobviousness as well.

The office action admits that the second step is "stressed" in JP 3-146679 but attempts to rely on Comparative Example 2 in JP 3-146679 as an anticipation in the following passage:

> Haruyuki [JP 3-146679] describes treatment of the titanium implant in a 1-6% solution of hydrofluoric acid for a time of 30 seconds to 3 minutes. ... Although Haruyuki stresses the use of a post treatment with hydrogen peroxide, the use of hydrofluoric acid alone is clearly contemplated in Comparative Example 2. The results described in Table 1. indicate that post treatment is not needed to affect the surface

properties. The purpose of the hydrogen peroxide post treatment is to reduce tissue irritation (Page 4 Line 30).

Applicants recognize that even a non-preferred disclosed embodiment or an embodiment that is disclosed and later disparaged can anticipate, and that "teaching away" is not relevant to anticipation. However, Comparative Example 2 does not anticipate the claims for two reasons.

First, as noted above, the treatment of Comparative Example 2 results in significant, intentional pits, i.e., morphological changes, and thus does not meet the limitations of all claims of treating under conditions without causing significant etching of the implant.

Second, the treatment of Comparative Example 2 is outside of the pH and concentration ranges of the independent claims. Comparative Example 2 recites: "4% HF, 1 minute no posttreatment." The 4% concentration of Comparative Example 2 is outside the 3% (or 2%) upper boundary of the range for claims 2, 10, 8, 17, and 18 and is below the 1.6 lower boundary for pH for claims 1 and 16. (As appears from the table above, a pH of 1.6 to 3 would have a concentration less than 2%.) The 1 to 6% range noted in the office action is only described in connection with the two-step invention, which is the entire thrust of this patent, and not in connection with the Comparative Example 2. As noted at page 3 of JP 3-146679:

> The invention additionally relates to a method for treating the surface of a titanium or titanium alloy biorepair member, wherein the aforesaid acid treatment comprises a pretreatment in which the surface of the aforesaid embedding portion is dipped in 1 to 6 weight % aqueous hydrofluoric acid (HF) solution for 30 seconds to 3 minutes followed by a posttreatment comprising dipping for 10 to 60 seconds in an aqueous mixed solution of 1 to 6 weight % aqueous hydrofluoric acid solution and 1 to 10 weight % hydrogen peroxide (H_2O_2) solution. (Emphasis added).

The entire thrust and teaching of this reference is the use of a two-step process. While there is a single isolated disclosure of a one-step procedure, it is for purposes of comparison only, and only describes a single concentration of 4%. The 1 to 6 % range described elsewhere with respect to the two-step procedure cannot be read into Comparative Example 2 under 35 USC 102(b). Once the basis becomes obviousness under 35 USC 103(a), the teachings and context of the entire reference must be

considered, and this reference clearly teaches away from the use of a single-step procedure involving the solution with the pH and concentration range claimed.

Applicants also submit that the claimed inventions of the independent claims are not obvious under 35 USC 103(a). The improved properties according to the present invention are believed to be based on a chemical effect associated with fluoride/fluorine retained on the surface of the implant, and no morphological effect is sought. On the contrary, morphological effects in the form of substantial etching are undesirable according to the present invention. Thus, the treatment of an implant with HF without causing significant etching of the implant provides a new and unexpected result.

JP 3-146679 gives no guidance whatsoever regarding any chemical alteration of implant surfaces, and in particular no guidance regarding retaining of fluoride/fluorine on such a surface. There is nothing in JP 3-146679 that even points in the direction of the present invention. Quite contrary, substantial etching of the implant surface is stated to be necessary to achieve an implant exhibiting an adequate biocompatibility (page 4).

Considering the above, a person skilled in the art wanting to improve the method described in JP 3-146679 would focus on a process resulting in morphological effects on the implants through the use of hydrofluoric acid in combination with hydrogen peroxide, and possibly other substances that would enhance the morphological effects.

Furthermore, since the combination with hydrogen peroxide is stressed in JP 3-146679, there is no reason to believe that a treatment with hydrofluoric acid alone would lead to the desired results. There is nothing in JP 3-146679, either explicitly stated or hinted, that would guide a person skilled in the art to anything resembling the method according to the present invention.

Accordingly, independent claims 1, 2, 8, 10, 16, 17 and 18 are not anticipated by JP 3-146679, as asserted in the office action, and moreover, are not obvious in light of JP 3-146679 under 35 USC 103(a). The remaining original claims depend on these independent claims and are allowable with them.

Applicant's have also added new claims 79-81, which do not specifically recite non-etching but do specify the HF concentration more specifically as 0.01% to 0.5%, preferably 0.1% to 0.5%, and particularly 0.2 to 0.5%, respectively.

Treatment of an implant surface with a solution of hydrofluoric acid of a concentration of 0.01 to 0.5% is not disclosed in JP 3-146679.

According to JP 3-146679, a HF concentration below 1% is not at all considered applicable since the pore size of the surface irregularities then will not reach 1 μm (page 4), i.e., substantial etching will not occur using a HF concentration below 1%. According to JP 3-146679, a pore size below 1 μm is considered as not desirable since the adhesive forces to the cells then are believed to be reduced (page 4). Thus, the treatment of an implant with 0.01-0.5% HF provides a new and unexpected result.

It is respectfully submitted that new claims 79-81 also define new and nonobvious subject matter and that they are allowable under 35 USC 102(b) and 103(a).